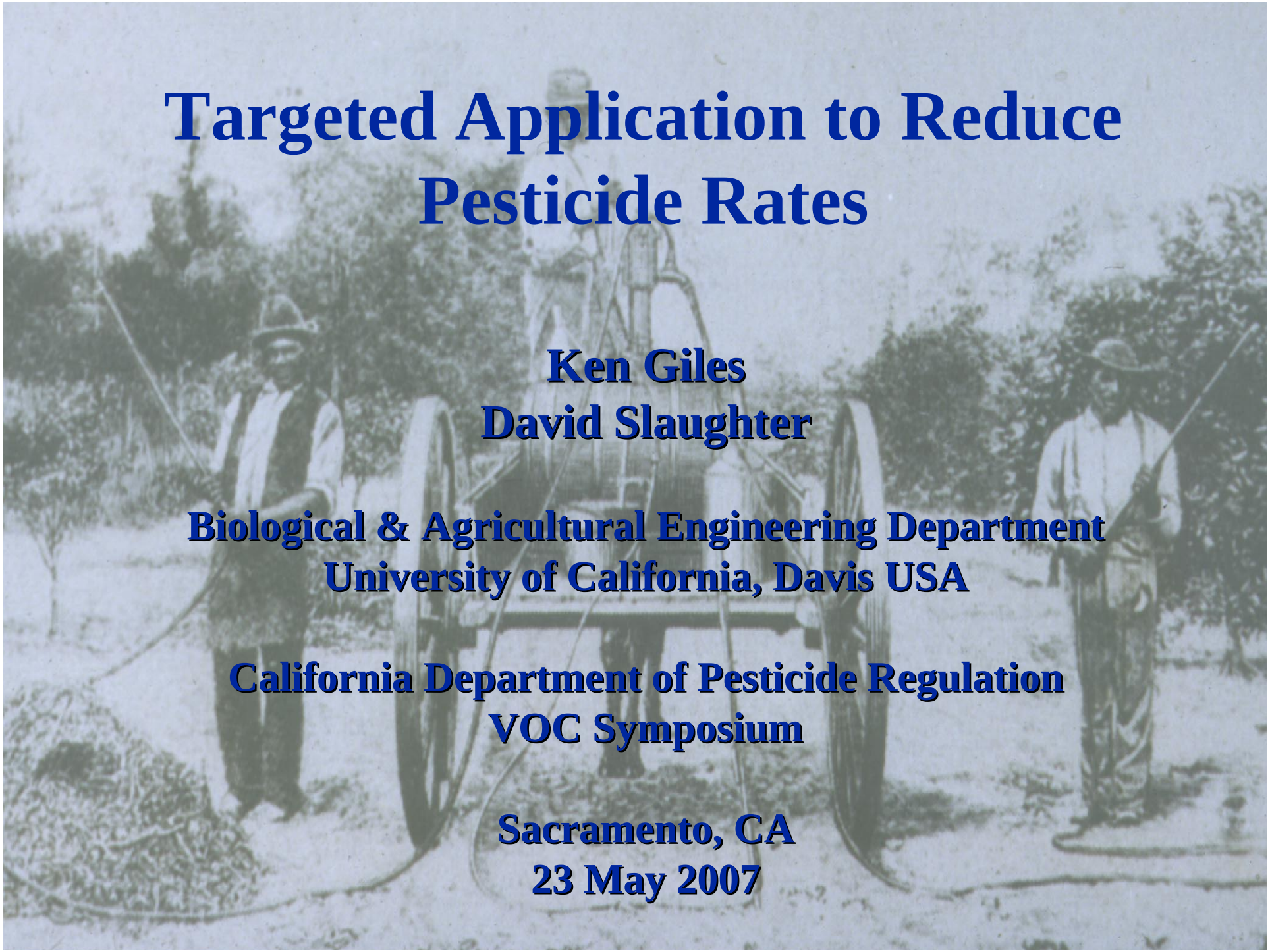

Targeted Application to Reduce Pesticide Rates

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VOC Symposium

Sacramento, CA
23 May 2007

Three critical aspects of ag spraying

Successful changes in practices address all three

Agrochemical application in California

Proximity to sensitive areas, either natural or man-made is common.

Tools to reduce application rates:

⇒ **Improved nozzles**
- **Droplet size management**
- **Better targeting**

⇒ **Adjuvants**
- **Reduce liquid rates**
- **Achieve small droplet quality deposition and efficacy with larger droplets**

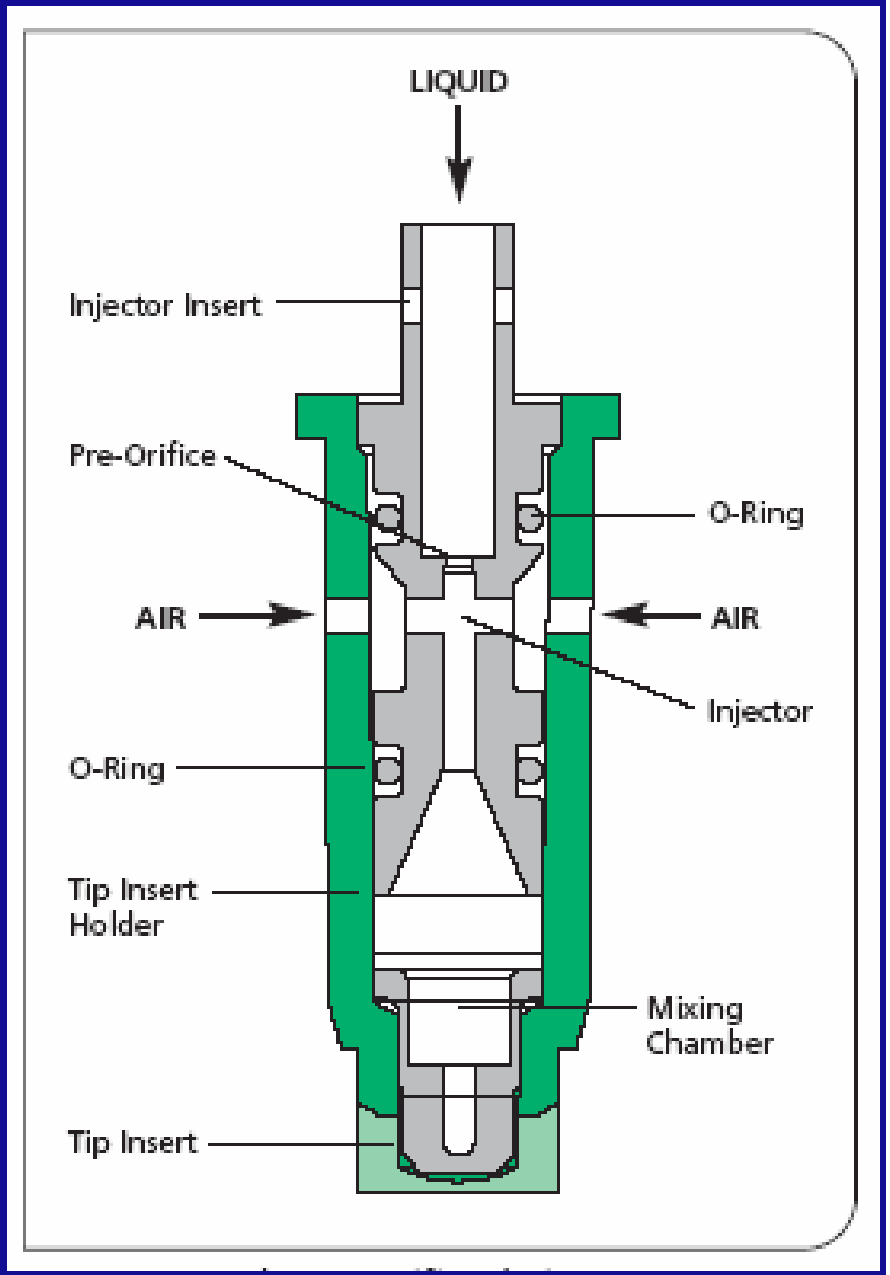
⇒ **Targeted application**
- **Sensors and controllers**
- **Reduce non-target deposition**

Nozzle Technology

- Trend toward larger droplets
- Using air induction
- Manipulating droplet velocities

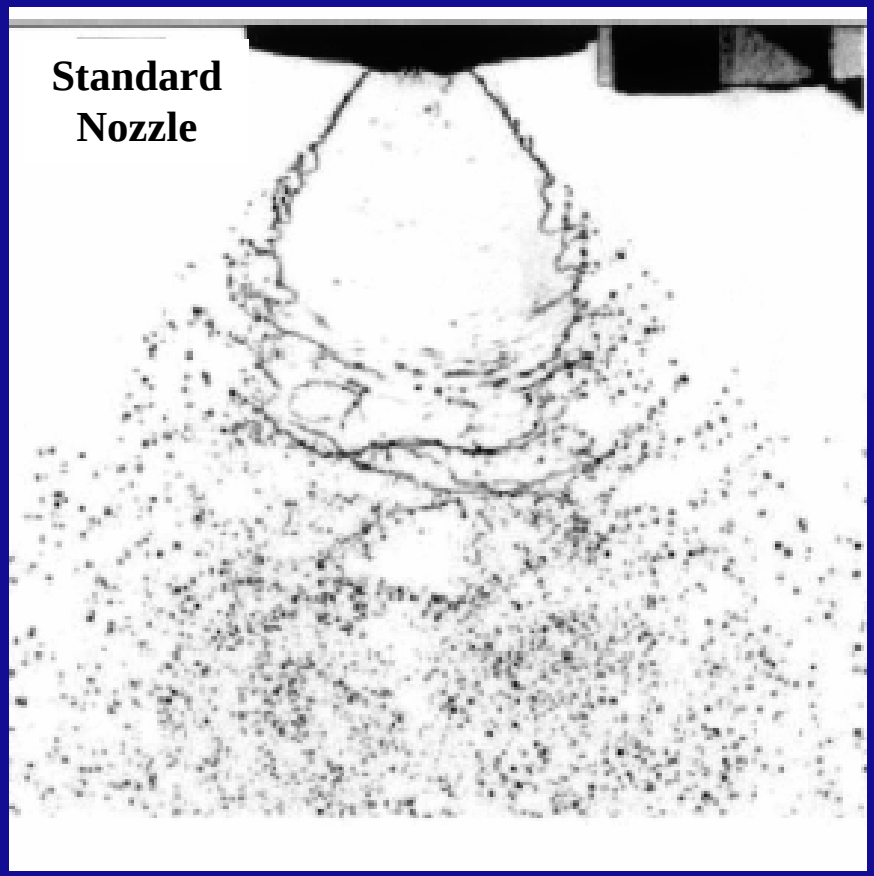
Air induction nozzle

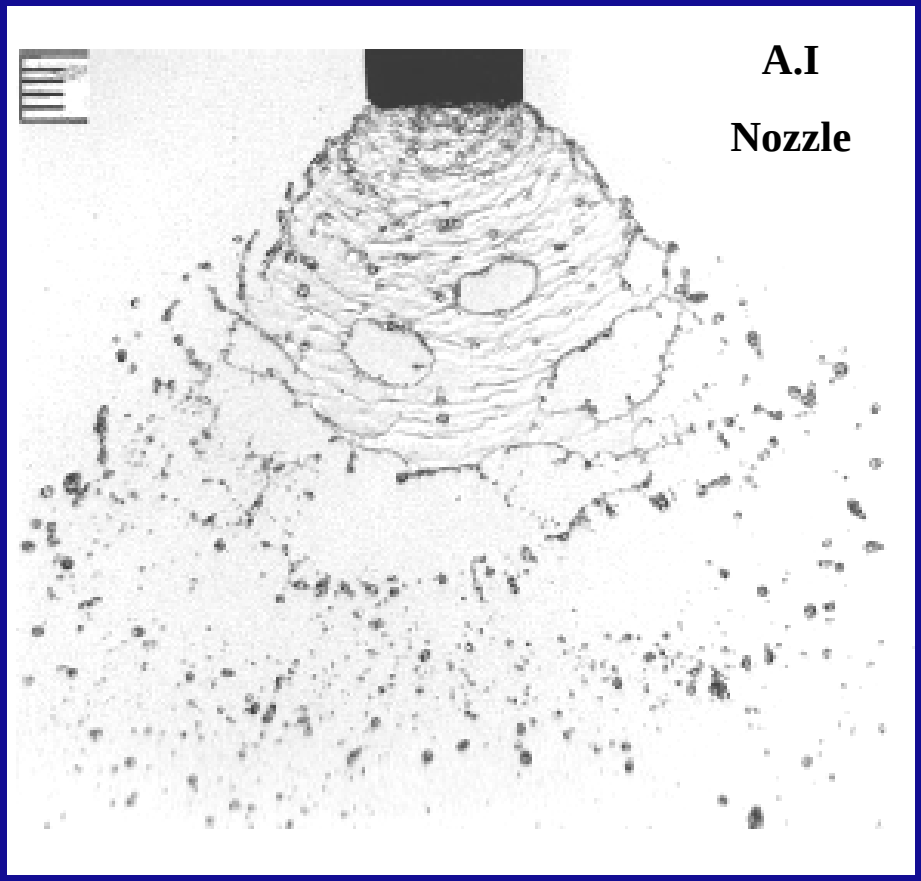
- A passive air flow
- Reduces small droplets
- Can create bubbles in droplets



Air induction nozzle

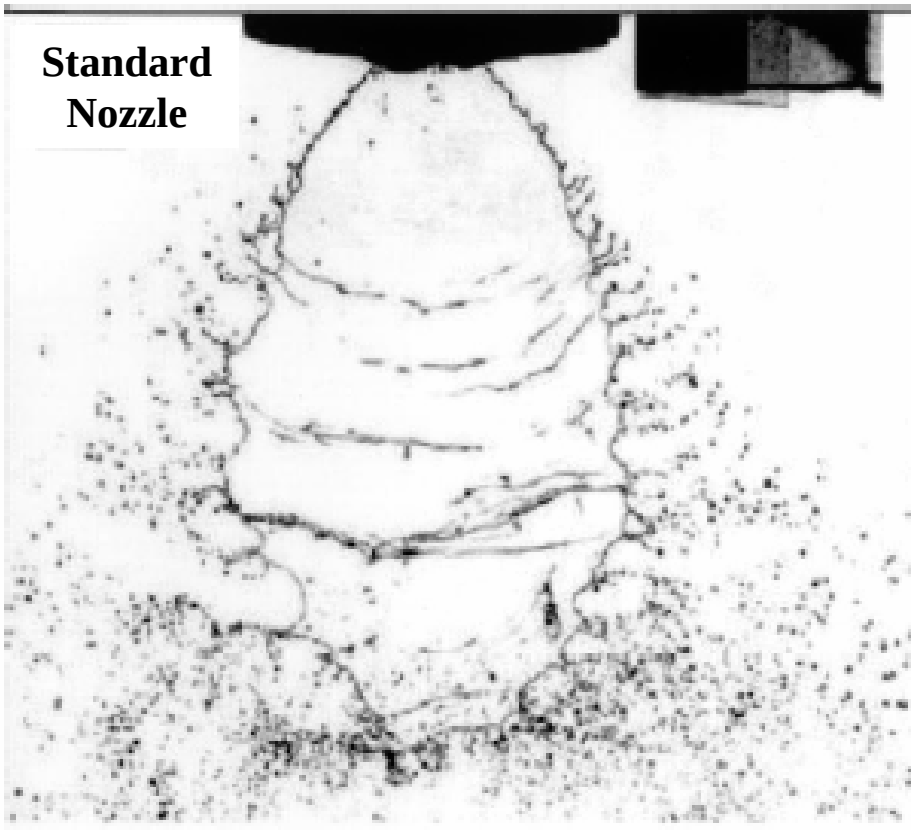
water

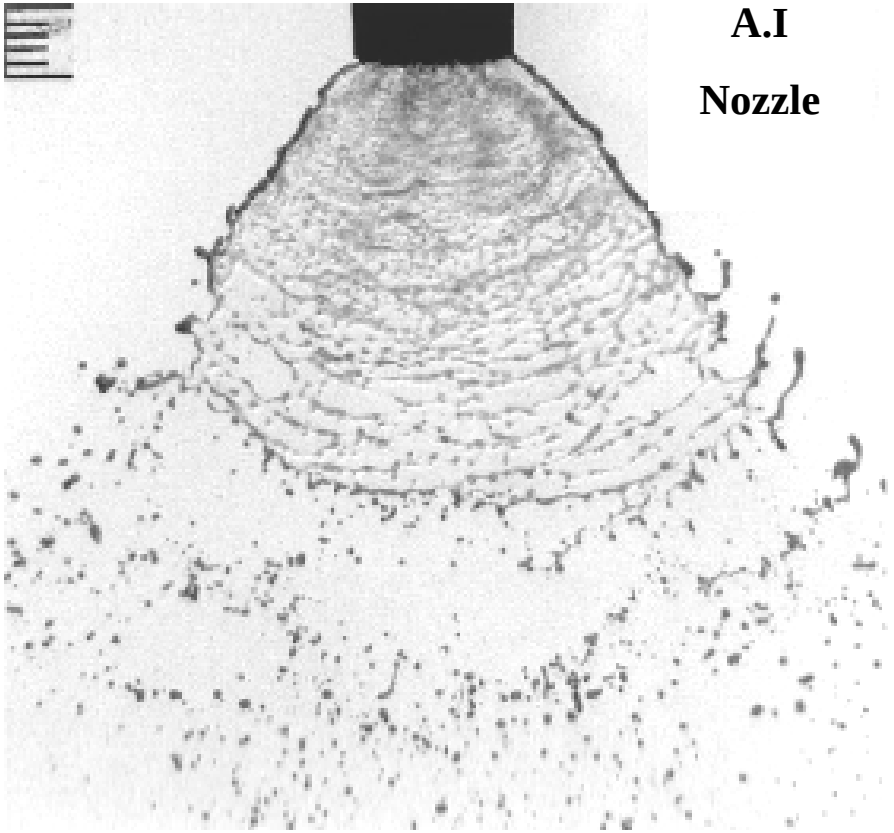




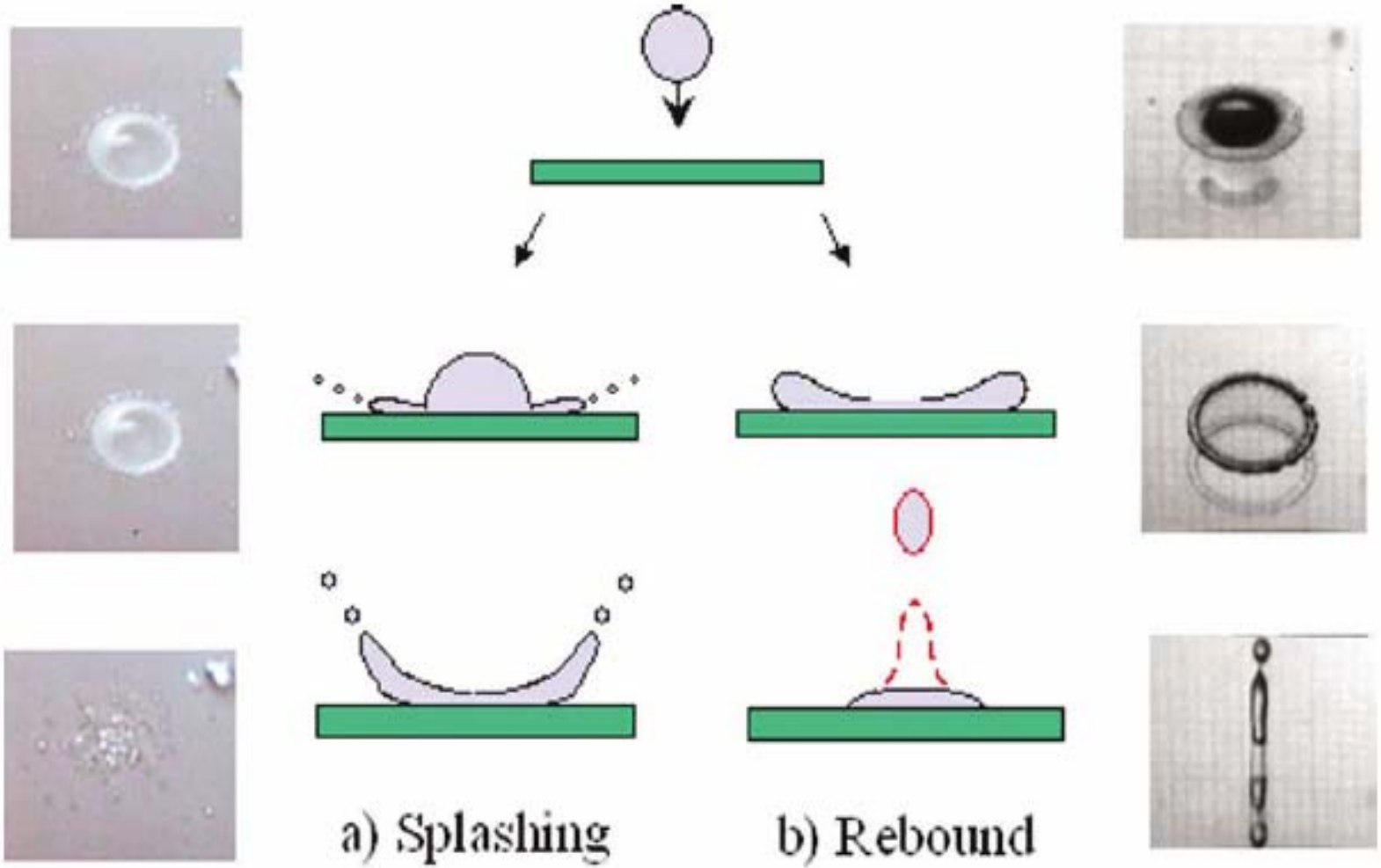
Air induction nozzle

water + 0.5% surfactant





Droplet deposition



Bergeron, 2003

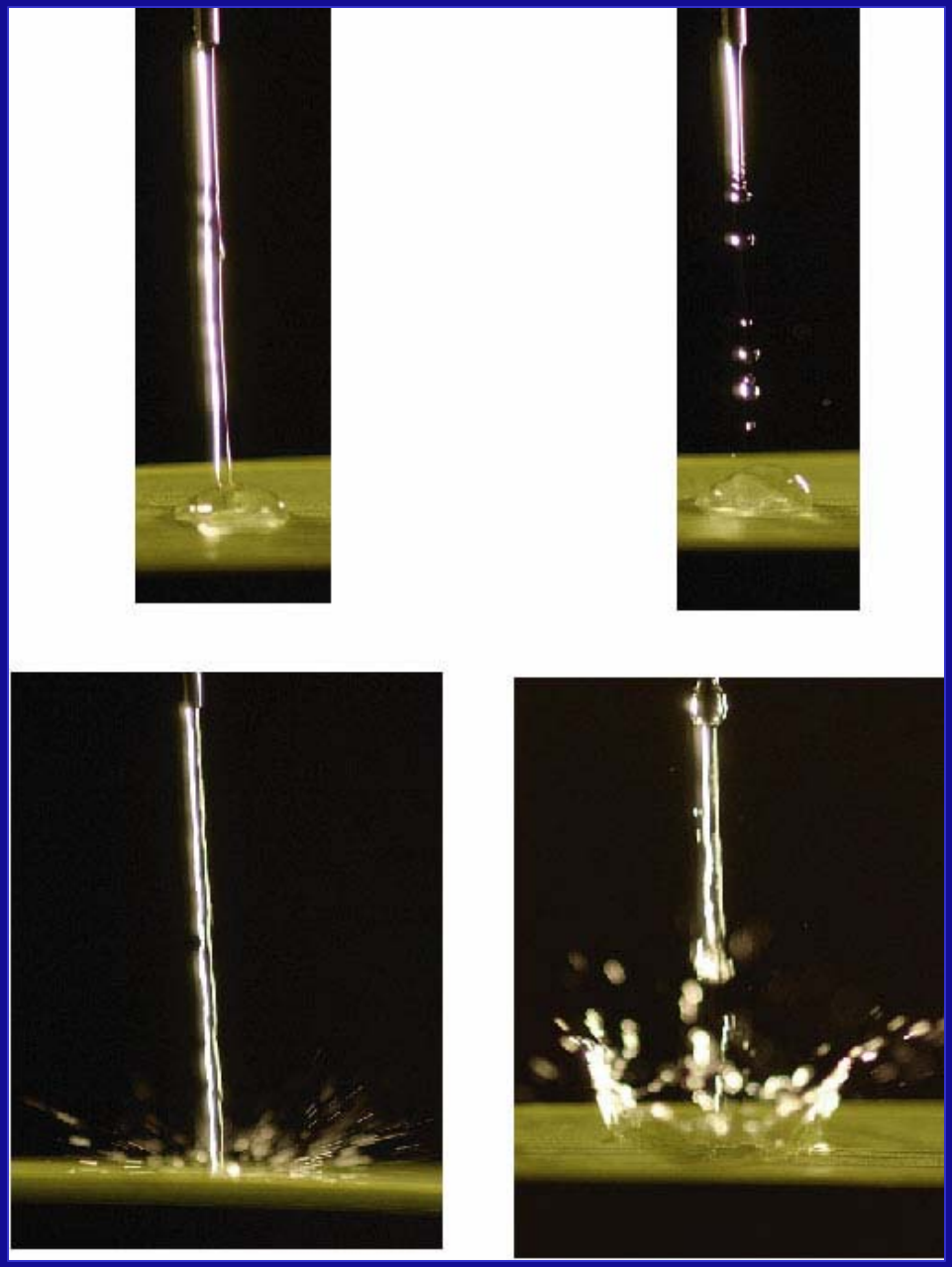
Water

0.508 mm orifice

5 cm distance

70 kPa

100 ms pulse



Poor spread

Water + surfactant

0.508 mm orifice

5 cm distance

70 kPa

100 ms pulse

Splash

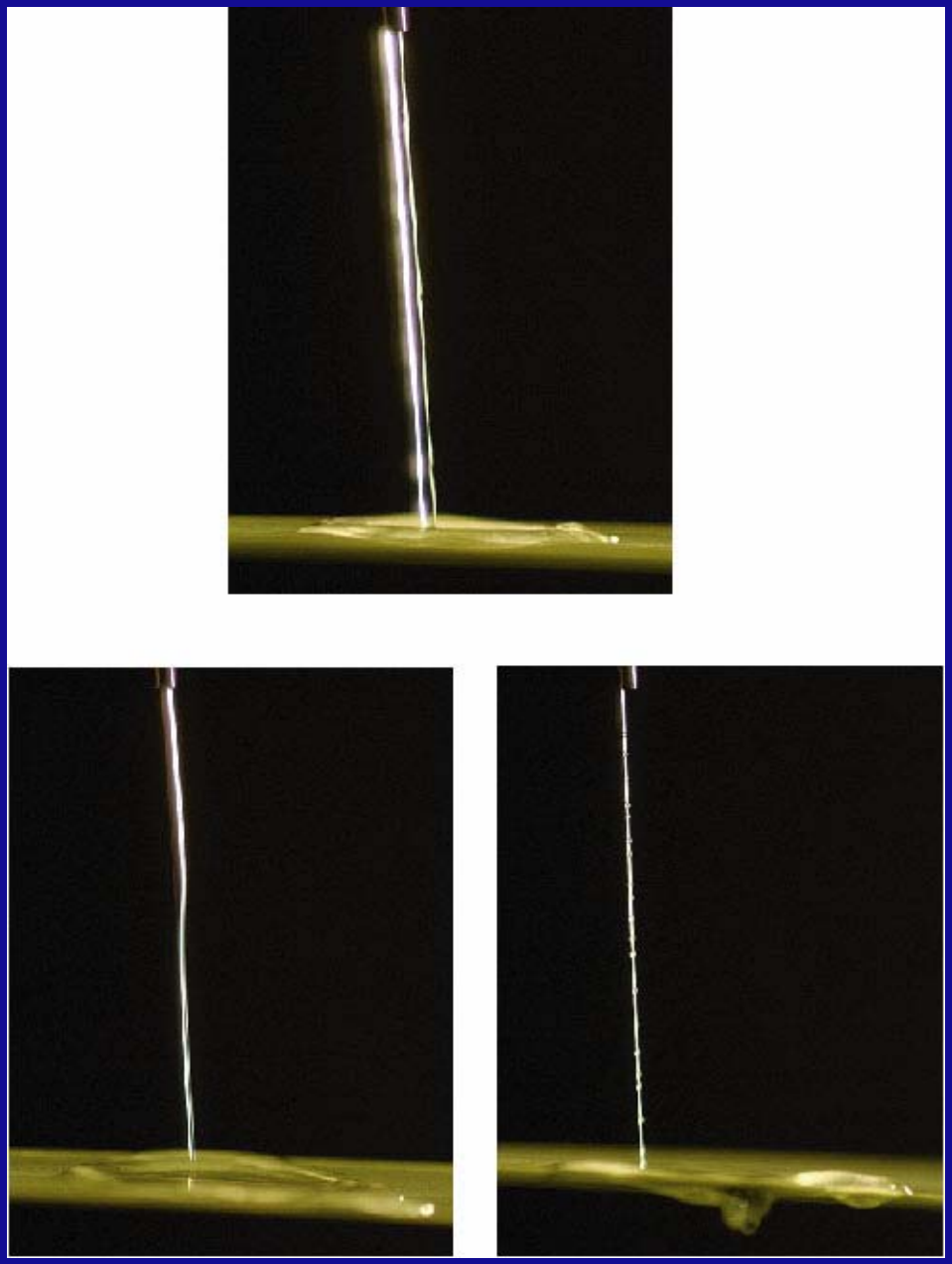
Water + surfactant + polymer

0.508 mm orifice

5 cm distance

70 kPa

100 ms pulse

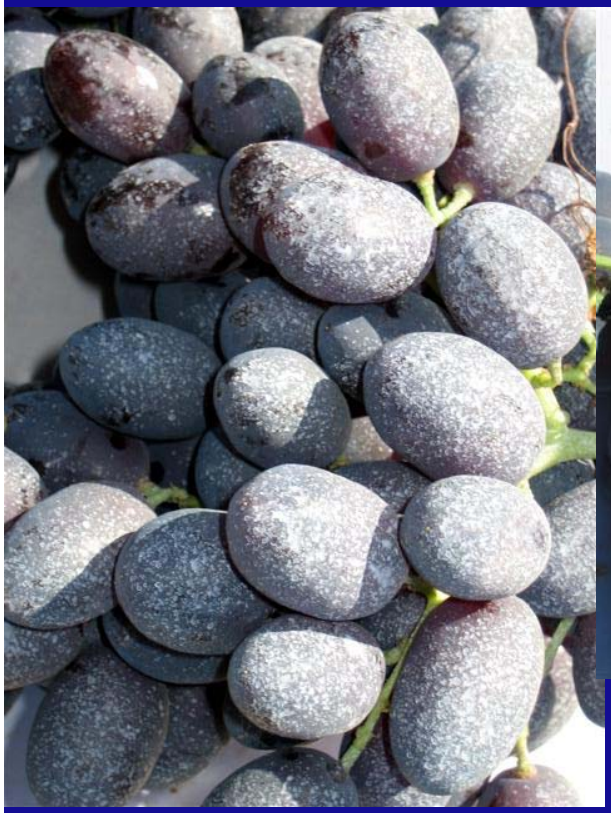


Good spread

Splash inhibited

Water without an adjuvant

Effect of adjuvant on deposition



Silicone surfactant
50 gallons / acre

No spray

No adjuvant
100 gal / acre

Grower standard
Air blast with
Disc-core at 200 gals/acre
With conventional spreader

Air blast
sprayer
AI nozzles
@ 160 gals/ac
W/ alternate
adjuvant

Multi-fan w/
AI nozzle
@ 40 gals/ac
w/ silicone

Miller *et al.* (2003) concluded:
"Most of the spray movement out of the tree canopy was in the spaces between trees…"

"One way to reduce drift may be to turn off the spray between tree crowns…

Spray deposit partitioning in orchards

Author	Condition	Ground	Target	Drift
Seiber	Dormant	25 – 45%	-	-
Cross	Both	43 - 63%	-	16%
Vercruysse	Both	-	56 – 68%	-
Pergher	In season	-	37 – 62%	-
Fox	“Sparse”	57%	-	-
Miller	In season	22%	57%	4.6 (16%)

Ultrasonic measurement of trees for control of spray sections.

Savings depends on orchard age, size, gaps, etc.

Some trials have shown 50 - 70 % savings.

Field test – dormant plums
Chico

Air-O-Fan 2D40 engine-driven sprayer

“Smart Spray” ultrasonic control system (retrofit)

Field test – dormant walnuts
Davis

Durand-Wayland AF500CPS PTO-driven sprayer

Nozzle configuration was “center-weighted” spray

Field test – sampling

Field test – dormant almonds
Ceres

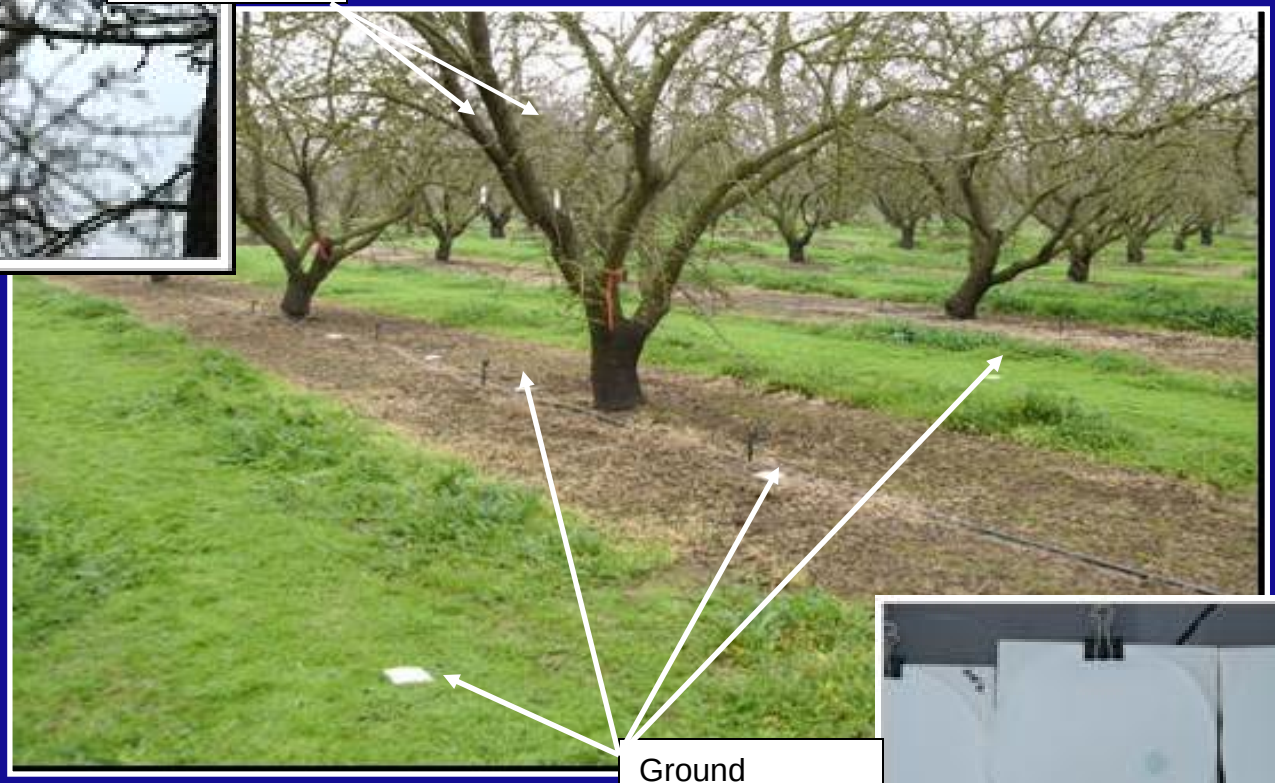
Durand-Wayland AF500 Smart Sprayer

Nozzle configuration was “center-weighted” spray

0.5 kg/ha Lorsban (chlopyrifos)

Deposition sampling - almonds

Tree samples, 2 m height



Ground samples

5 m height, 240 trees/ha

Performance results

3 crops, 3 chemicals, 3 sprayers, 3 locations, 3 operators …

Use of system had no significant effect on target deposition

- Plum orchard –
  - 15% reduction in a.i. rate
  - 5% less ground deposit
- Walnut orchard –
  - 45% reduction in a.i. rate
  - 58% less ground deposit
- Almond orchard -
  - 22% reduction in a.i. rate
  - 71% less ground deposit

Based on these results, a run-off experiment was conducted in a 40 acre prune orchard in Biggs.

Field test – Prunes
Biggs

Durand-Wayland AF500 Smart Sprayer

Measurements:

Spray savings
Ground deposit
Runoff

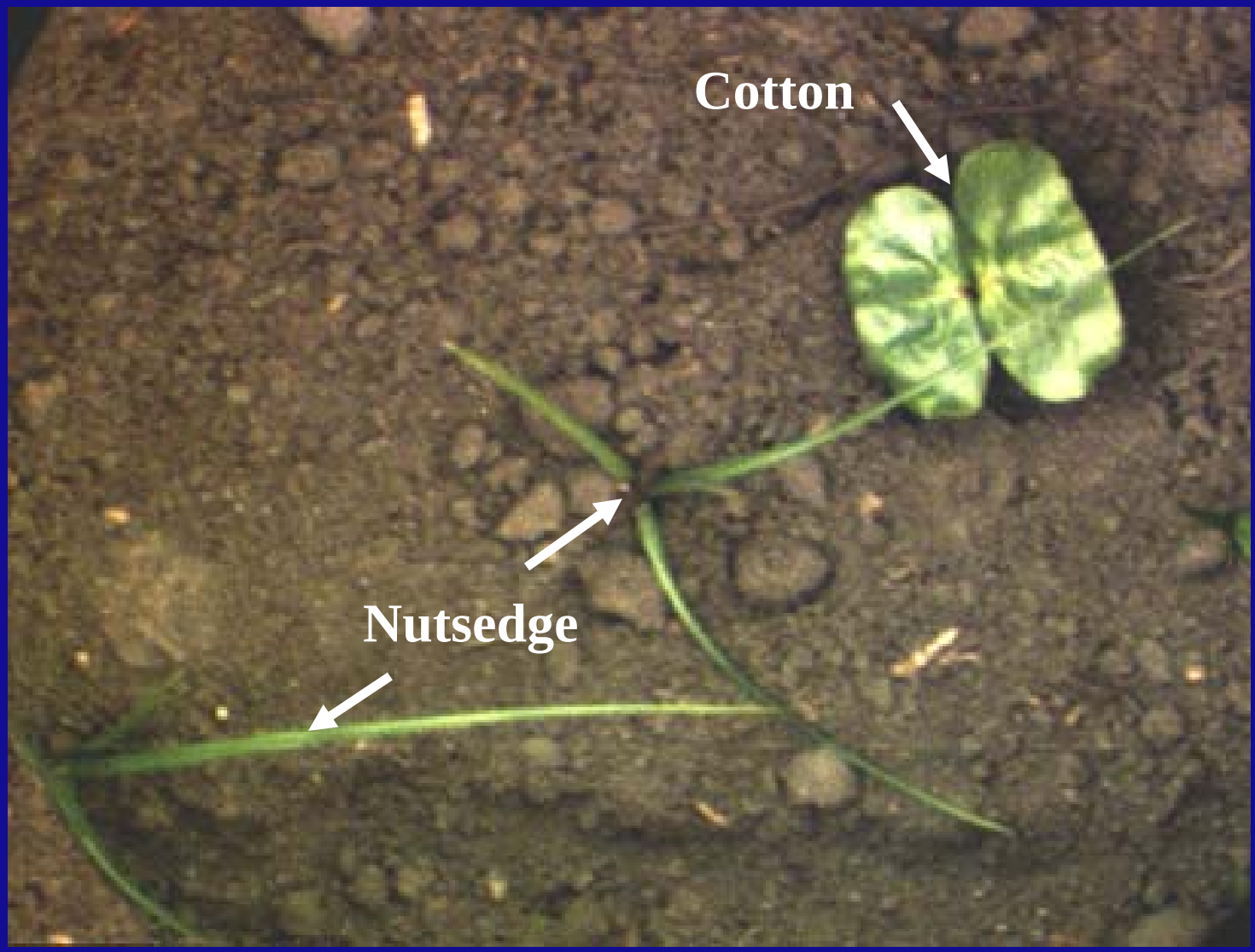
Results from “Smart” Spraying

Spray Savings: 39%

Ground Deposit: - 54%

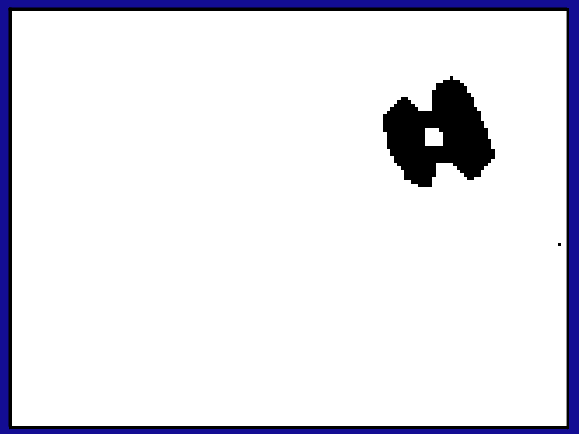
Diazinon in Runoff: - 44%

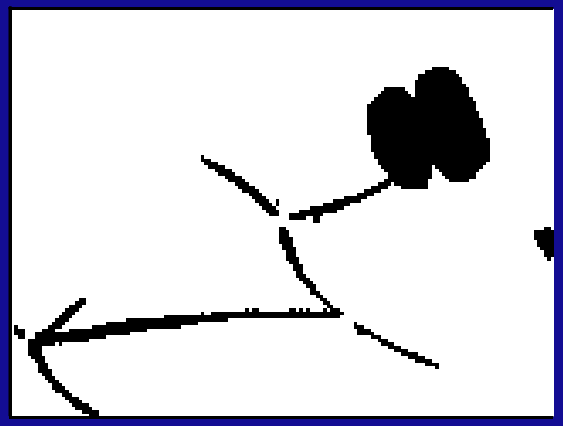
A typical target scene within the row

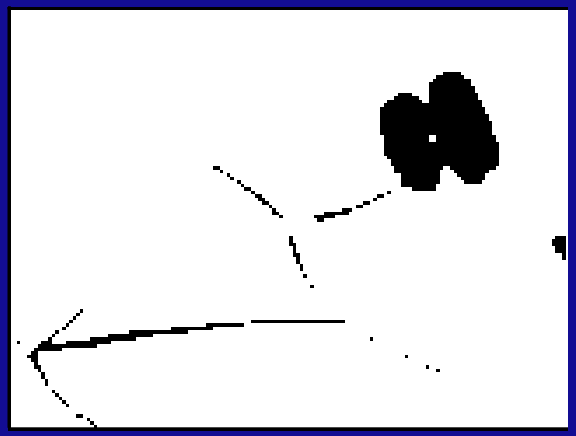


A typical target scene within the row

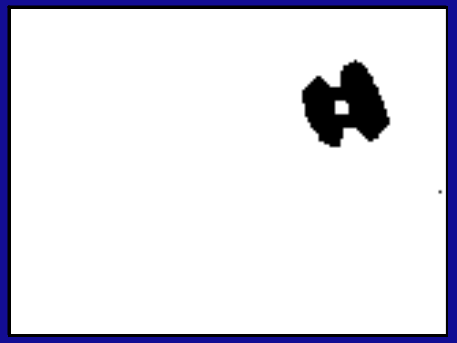
Process for image analysis



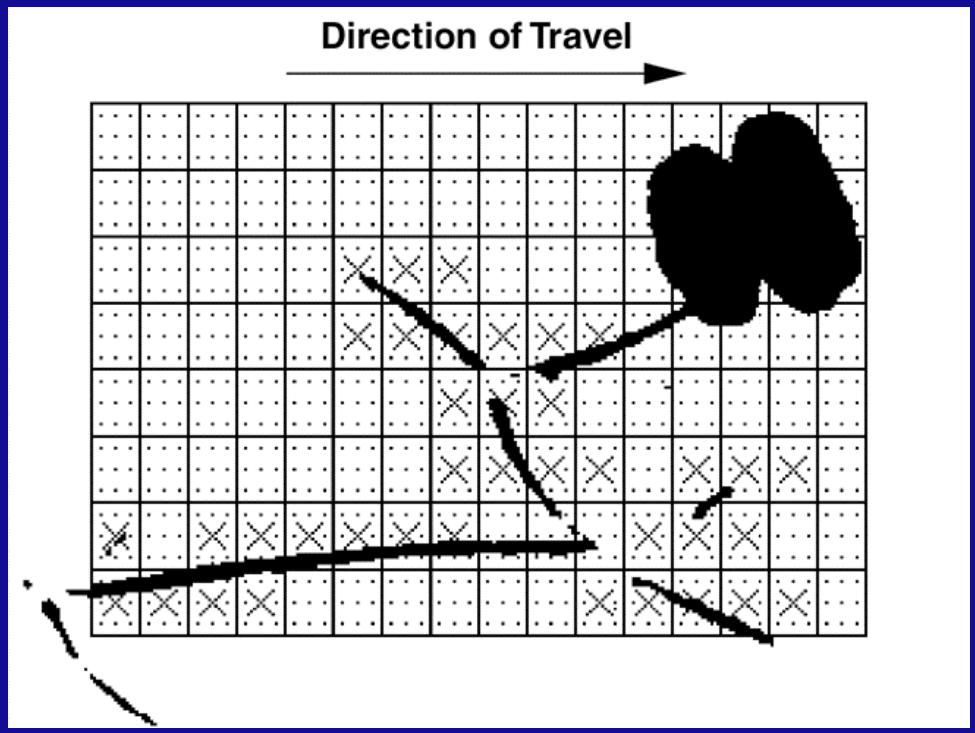


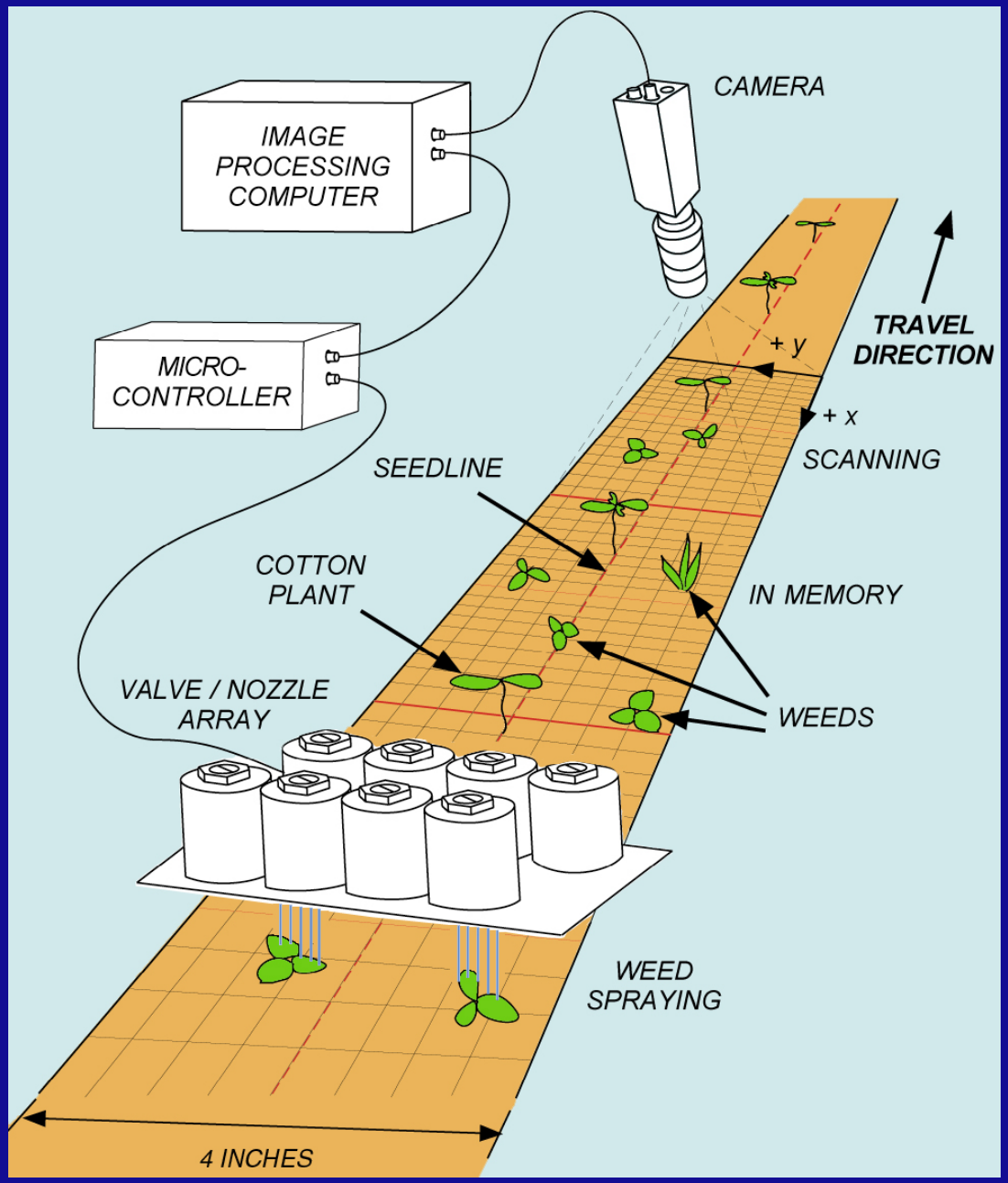


Generating a precise spray micro- map (10 cm x 15 cm)



Replacing chemical selectivity with spatial selectivity





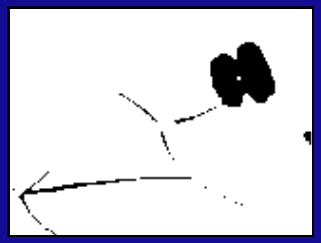
The concept..

"Leaf-specific" agriculture

Process for spatially selective application of non-selective herbicide

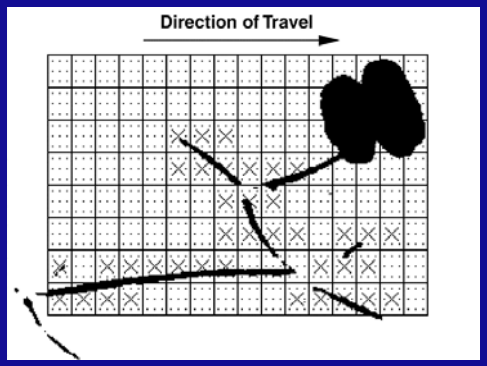
(a)

(b)



(c)

(d)



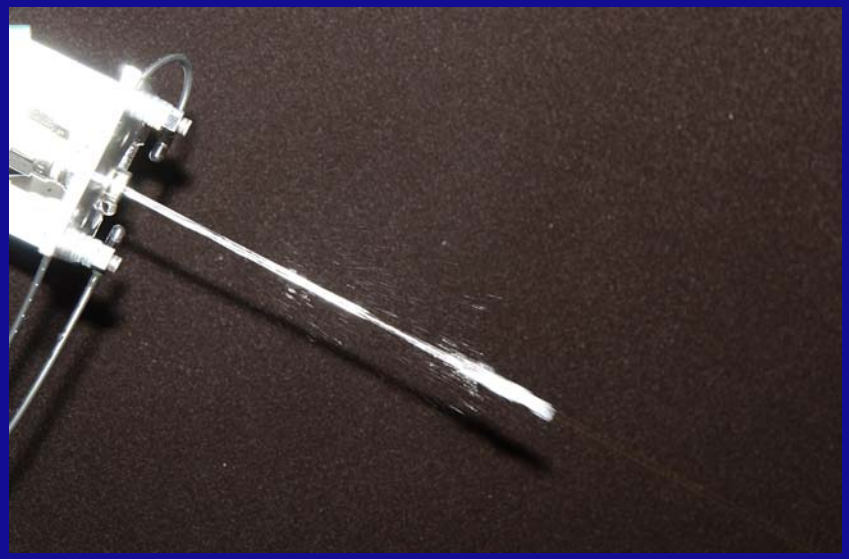
(e)

Micro boom and micro boom sections of micro nozzles

One micro boom section per cell

Fast valves for flow control

Micro-nozzles for dosing

Target plants

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